

**JPL STANDARD**

**for**

**TAILORING PROJECT PARTS PROGRAM DOCUMENTS**

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## FOREWORD

The policies which govern the selection, application and acquisition of electronic parts have a profound influence on the performance and reliability of flight equipment, and a smaller influence on project cost. Historically, the cost for the electronic parts and associated labor has varied between about 4% to 7% of the total spacecraft development cost for a JPL flight project.

The "Blueprint for Change" issued by Secretary of Defense William Perry, the decreasing market share that military and high-reliability parts represent and changes in the market have all conspired to significantly change the way spaceborne electronic parts are selected, specified and purchased. Many new and attractive parts are not manufactured to military or high-reliability specifications and are supplied only as commercial parts. Commercial parts are often supplied untested. Samples of commercial parts evaluated by designers for suitability in flight hardware may perform quite differently from lots purchased only a few months later.

This Standard should be used by all JPL flight projects to "tailor" electronic parts policies for the project to provide guidance for the designers of flight electronic hardware, and for the people responsible for the project parts management, whether they work for JPL or for JPL contractors or subcontractors. The policies will vary with mission objectives, risk tolerance and available funding. The risk associated with electronic parts applications is best assessed when information about the parts is detailed and comprehensive. Much of the tailoring will deal with the tradeoff between the risk knowledge achieved by acquiring the requisite information about the parts to be used, and the associated cost in time and money to acquire that knowledge.

This Standard does not contain any "minimum acceptable" parts requirements because it is intended to be used for all kinds of flight projects from shuttle or balloon-borne, recoverable science instruments to deep space/long lifetime spacecraft and science instruments.

Policies covering part selection and application can be satisfied with more than one methodology. The goal of a tailored project parts document is to delineate policies clearly and specifically very early in the project life cycle.

The intent of this Standard is for project management and electronic parts engineering people to work together as a team to establish policies which will produce electronic hardware capable of meeting the project requirements.

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## **STANDARD for TAILORING PROJECT PARTS PROGRAM DOCUMENTS**

### **SCOPE:**

This Standard is for the tailoring of Project Parts Program documents for specific projects. The Project Parts Program will be tailored to the needs of each individual project. The tailoring will be based on the project's risk tolerance, budget, mission length and environment, schedule and other considerations. This Standard is a sub-tier Standard to D-12872, JPL Process for Tailoring Mission Assurance to Specific Projects.

### **APPLICABILITY:**

This standard establishes preferred engineering practices for JPL programs and projects. It is not self-imposing, but may be imposed as a technical requirement at the option of the selecting project or program, or cited as a reference for guidance in a performance-type contract.

### **APPLICABLE DOCUMENTS:**

#### **Military Documents**

MIL-STD-975M

NASA Standard EEE Parts List

#### **JPL Documents**

D-8546

Derating Guidelines, Electronic Parts Reliability Office

D-11119

Alerts/Concerns Handbook

D-12872

JPL Process for Tailoring Mission Assurance to Specific Projects

D-13277

Risk/Requirements Trade-off Guidelines for Faster, Better, Cheaper Missions

### **PARTS POLICIES TAILORING PROCESS:**

The preparation of a project parts program document is a tailoring process that involves addressing a considerable number of parts technology elements. For each element there are several options. The Check List starting on page 4 identifies the options and provides a form to document the choices made. Note that most of the listed items need to be addressed whether or not the hardware is built at JPL. In the cases where there is a system contract for a spacecraft or a science instrument, the contractor should prepare a Project Parts Program document for the electronic design engineering required by the contract.

The Check List consists of two sections. Section A is for the definition of the project characteristics and parts program management. Section B is for the selection of the parts technology elements to be included in the parts program. Each item in Section B represents activities which experience has shown can enhance the probability of mission success. Each

activity has a corresponding cost in dollars and schedule, however, that must be weighed against project resource constraints and the project tolerance to risk acceptance.

A tailored Project Parts Program document records the project's parts requirements after consideration has been given to the appropriate cost/benefit for each parts technology element relative to mission requirements, cost and schedule. These decisions are best made in meetings between a JPL Office 507 project Parts Interface Engineer (PIE) and the project office managers. Some of the requirements or activities in the Check List may be irrelevant for a some projects, or not selected based on cost/benefit assessment results. The selection of the requirements or activities should be made explicit with YES or NO answers. Minimum requirements for the various elements should be discussed with the project office managers during the filling in of Section B of the Check List.

### **IMPLEMENTATION of THIS STANDARD:**

This Standard is accessible on the Office 507 computer network. After the Check List has been filled out by project representatives and an Office 507 PIE, the PIE will convert the Check List into a Project Parts Program document for the intended project. The document should be drafted during the pre-project period and made a part of JPL's proposal to the sponsor for the project. The approved project document should be available before the design of JPL hardware starts, and in time for the solicitation of proposals for electronic hardware contracts.

For system contracts, a high level version of the Project Parts Program document should be prepared and made an exhibit in the request for proposal. The system contractor should be required to prepare and submit a Project Parts Program document that describes the elements of the parts program he would implement.

The successful implementation of the Project Parts Program requires the active cooperation of all who will be affected by the requirements in the document. It behooves the project to obtain their prior approval before committing them to a specific course of action. For example:

- Cognizant hardware engineers buying their own parts should agree to document their procurement procedures.

- GIDEP Alert checking and closure by a contractor throughout the period of work the contract covers must be in the contract statement of work.

- A requirement for reclamation by JPL of excess parts purchased by a system contractor must be enforced by a clause in the contract which echoes this requirement.

- The derating requirements must be compatible with the Worst Case Analysis (WCA) requirements.

- The environmental requirements for the parts must be compatible with the project environmental requirements documents.

## **REVISIONS:**

It is anticipated that revisions to specific Project Parts Program documents may be necessary after they have been released for use, e.g., the negotiation of electronic hardware contracts could lead to the acceptance of certain contractor parts policies or procedures that differ from the released document. Another reason for revision would be a significant change in the environmental requirements. The Project Parts Program document should be changed when necessary so that the document accurately reflects the agreed upon requirements and any subsequent changes to those requirements.

## CHECK LIST FOR A PROJECT PARTS PROGRAM DOCUMENT

### SECTION A. PROJECT CHARACTERISTICS & PARTS PROGRAM MANAGEMENT

#### 1. **Electronic Hardware Identification**

Identify all spacecraft hardware subsystems and instruments by name and provider for all assemblies containing electronic parts in an attached list. Indicate which electronic hardware (if any) is heritage hardware. If the project is a spacecraft project with a systems contract for the spacecraft, identify the contractor, enter "all spacecraft subsystems", and attach a list of the science instrument names and providers. If the project is for a science instrument, so indicate with the instrument name and provider.

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- 1a. Identify the types of electronic hardware to which this Project Parts Program document must apply with a YES or NO.

\_\_\_\_\_ Breadboard or Brassboard (BB)  
\_\_\_\_\_ Engineering Model (EM)  
\_\_\_\_\_ Protoflight Model (PFM)  
\_\_\_\_\_ Flight Model (FM)

#### 2. **Mission Lifetime**

Identify the mission lifetime requirements for:

A minimum mission, \_\_\_\_\_ years

An extended mission, \_\_\_\_\_ years

#### 3. **Mission Environment**

Assessing each flight part for its capability to withstand the mission environment is a powerful tool to assure in-specification performance during flight. There is a discussion of the **space single events phenomena** in a section of JPL document D-13277 that is useful in gaining an understanding of the subject.

Quantify the elements of the mission environment shown in the following table, and indicate where parts assessment should be performed.



**Mission Environments:****Parts Assessment****All Parts      Critical Parts****Hardware temperature ranges:**

Hardware qualification:	_____ °C min., _____ °C max.	_____	_____
Flight allowable:	_____ °C min., _____ °C max.	_____	_____

**Radiation:**

Total integrated dose (TID):	_____ rad-Si.	_____	_____
Single Event Latchup (SEL) threshold:	_____ LET/mg/cm sq.	_____	_____
Single Event Upset (SEU) threshold:	_____ LET/mg/cm sq.	_____	_____
Single Event Upset Rate:	_____ per year	_____	_____
Single Event Burnout (SEB) threshold:	_____ LET/mg/cm sq.	_____	_____
Single Event Gate Rupture (SEGR) threshold:	_____ LET/mg/cm sq.	_____	_____

**4. Parts Program Management**

4a. Identify the desired Office 507 participation in the following activities:

- \_\_\_\_\_ Pre-project parts planning and Project Parts Program document preparation
- \_\_\_\_\_ Evaluation of contractor proposals regarding electronic parts
- \_\_\_\_\_ Concurrent parts engineering support during the design process
- \_\_\_\_\_ Conceptual Design Reviews
- \_\_\_\_\_ Monthly Management Meetings
- \_\_\_\_\_ Preliminary Design Reviews
- \_\_\_\_\_ Critical Design Reviews
- \_\_\_\_\_ Hardware Review/Certification Requirement (HRCR) Meetings
- \_\_\_\_\_ Preship Review

4aa. If the desired participation varies within the project, identify the hardware to which the activities selected in 4a apply, or attach a table. \_\_\_\_\_

4b. Identify the Office 507 reporting desired for JPL-built hardware.  
Typical metrics reported would be parts list review results, parts acquisition, screening and kitting status and GIDEP Alert closure results.

Check one:

- \_\_\_\_\_ Formal monthly presentation of parts status.
- \_\_\_\_\_ Hard copy monthly status reports.
- \_\_\_\_\_ Occasional hard copy parts status reports, when requested.
- \_\_\_\_\_ On-line, remotely accessible, monthly status reports
- \_\_\_\_\_ Other \_\_\_\_\_

- 4c. For contractor-built spacecraft hardware, identify the Office 507 reporting desired.  
\_\_\_\_\_
- 4d. \_\_\_\_\_ Will the science instrument providers be given responsibility for their own parts?  
(yes or no)
- 4e. Identify the Office 507 support desired for the instruments:  
\_\_\_\_\_ Parts list review for part reliability  
\_\_\_\_\_ Parts list review for radiation sensitivity  
\_\_\_\_\_ Providing parts from the JPL parts stores  
\_\_\_\_\_ Assistance in procuring parts  
\_\_\_\_\_ GIDEP Alert distribution  
\_\_\_\_\_ GIDEP Alert closure  
\_\_\_\_\_ Electronic Parts failure analysis  
\_\_\_\_\_ Other services (TBD) \_\_\_\_\_
- 4f. Identify the level of effort expected for Office 507 parts program management.  
\_\_\_\_\_ Project parts manager and several Parts Interface Engineers (PIE)  
\_\_\_\_\_ One full time PIE  
\_\_\_\_\_ Part time PIE  
\_\_\_\_\_ Dedicated non-engineering parts representative
5. **Problem/Failure Reporting**  
\_\_\_\_\_ Will the project utilize a problem/failure reporting system? (yes or no)
6. **Waivers**  
\_\_\_\_\_ Will the project require waivers for deviations from the established parts requirements? (yes or no)

## SECTION B. ELECTRONIC PARTS PROGRAM

### 1. **Parts Selection**

It is recommended that a list of standard or preferred electronic parts be established to assist the parts selection process. These parts will be chosen based on their reliability history, use on prior JPL projects and knowledge of their space radiation sensitivity.

- 1a. ☐ A list of standard or preferred electronic parts and their manufacturers shall be established for the project.

- 1aa. The standard or preferred parts list shall consist of (check one):

☐ Grade 1 parts only, per MIL-STD-975, or equivalent  
☐ Grade 1 and Grade 2 parts, per MIL-STD-975, or equivalent  
☐ Grade 1 and Grade 2 parts, or equivalent, **and** (specify other sources or lists of preferred parts) \_\_\_\_\_  
☐ Other list(s): \_\_\_\_\_

- 1b. ☐ A standard or preferred parts list is not required (yes or blank). If yes, indicate why \_\_\_\_\_

### 2. **Parts List Capture**

Parts lists are needed for reliability and radiation reviews (if required), GIDEP Alert searches, and parts acquisition. The parts lists shall be received by the Office 507 PIE and entered into the JPL Electronic Parts Information Network System (EPINS).

- 2a. The required parts lists for JPL-built hardware are (check one or more):

☐ Long lead time parts  
☐ Pre-PDR list  
☐ Pre-Heritage Review list  
☐ Pre-CDR list  
☐ As-built lists

- 2b. ☐ Parts lists for contractor-built hardware shall be provided to JPL (yes or no).

If yes, the parts lists will be provided before:

(check one or more)

☐ PDR  
☐ CDR  
☐ Heritage Review  
☐ Hardware delivery to spacecraft integration

- 2c. ☐ Parts lists for instruments shall be provided to JPL (yes or no).

If yes, the parts lists will be provided before:

(check one or more)

- ☐ PDR
- ☐ CDR
- ☐ Heritage Review
- ☐ Hardware delivery to spacecraft integration

3. **Parts List Reviews**

If a standard parts list is established, all parts not on the standard parts list shall be considered to be nonstandard or special parts. These parts will receive the most attention during the parts list reviews and assessment. The purpose of a parts assessment activity is to provide informed guidance to the parts users about the reliability status and ability to meet the environmental conditions of the project.

- 3a. The following parts lists for JPL-built electronic hardware and science instruments shall be reviewed for compliance with the specified project parts requirements

(check one or more):

- ☐ Preliminary parts lists
- ☐ Commercial assembly parts lists
- ☐ As-designed pre-CDR parts lists
- ☐ Heritage hardware parts lists
- ☐ As-built hardware parts lists prior to flight hardware delivery

- 3b. The following parts lists for contractor-designed and built electronic hardware shall be reviewed by JPL's Office 507 for compliance with the specified project parts requirements (check one or more):

- ☐ Preliminary parts lists
- ☐ Commercial assembly parts lists
- ☐ As-designed pre-CDR parts lists
- ☐ Heritage hardware parts lists
- ☐ As-built hardware parts lists prior to flight hardware delivery

- 3c. The following parts lists for non JPL-built science instruments shall be reviewed by JPL's Office 507 for compliance with the specified project parts requirements:

- ☐ Preliminary parts lists
- ☐ Commercial assembly parts lists
- ☐ As-designed pre-CDR parts lists
- ☐ Heritage hardware parts lists
- ☐ As-built hardware parts lists prior to flight hardware delivery

4. **Test Specification Preparation**

There may not be any existing acceptable procurement specifications for some of the nonstandard parts, particularly the newer high technology parts (microcircuits, hybrid circuits, microwave components, etc.) The acceptability of existing procurement specifications will be determined by the Office 507 part specialists, based on the project

requirements, type of mission, etc.. The alternative to having acceptable test specifications that are intended for space flight applications is to have the parts tested to the manufacturer's data book parameter limits, or to do without parameter testing.

- 4a. Part test specifications shall be prepared by JPL, or by the contractors for parts in contractor-built hardware, when no acceptable specification exists: YES \_\_\_\_ NO \_\_\_\_

5. **Electronic Parts Acquisition**

Check one or more:

- \_\_\_\_ Shall be the responsibility of Office 507 for JPL-built hardware, and each contractor and science instrument organization for the parts in their hardware.  
 \_\_\_\_ JPL will GFE certain parts (TBD) to contractor or instrument organizations from the project parts stock on hand, when requested.  
 \_\_\_\_ JPL will buy certain parts (TBD) for the contractor or instrument organizations

- 5a. \_\_\_\_ For spacecraft hardware (excluding instruments), procure all flight diodes, transistors, microcircuits, and hybrid circuits with active components, with: tri-temperature attributes & variables electrical test data \_\_\_\_ (yes or no),

OR

tri-temperature attributes test data only \_\_\_\_ (yes or no).

- 5aa. \_\_\_\_ Extend the 5a requirement to the instruments (yes or no).

- 5b. \_\_\_\_ Procure all flight microcircuits, hybrid circuits, resistor networks, relays and transistors with X-ray radiographs (yes or no). The JPL document D-13277 has a section on **Quality Assurance Flight Electronic Parts X-ray Inspection**.

- 5bb. \_\_\_\_ Extend the 5b requirement to the instruments (yes or no).

- 5c. \_\_\_\_ Procure all custom microcircuits, custom hybrid circuits and relays with JPL pre-seal inspection.

6. **Parts Receiving, Handling, Kitting and QA Inspections**

When electronic parts intended for flight use are received by JPL, contractors or instrument builders, the following receiving inspections shall be performed:

	JPL	Ctr.	Inst.
QA visual inspection of active parts for handling damage and conformance of the part markings to the purchase order. JPL document D-13277 has a section on <b>Quality Assurance Flight Electronic Parts Receiving/Post-Screen/Kitting Inspection</b> .	____	____	____
QA X-ray inspection. Reference D-13277.	____	____	____

Electrical test of microcircuits and other part categories TBD \_\_\_\_\_

Destructive Physical Analysis (DPA) of samples of all microcircuit lots and other part categories. \_\_\_\_\_  
(JPL document D-13277 has a section on **Electronic Parts Destructive Physical Analysis.**)

- 6a. \_\_\_\_\_ Review the electrical test data for compliance with the part specifications, OR  
\_\_\_\_\_ Store the electrical test data, without variables data review, for possible subsequent use in cherry picking the best parts for certain applications, or for statistical analysis, or for review during part failure analysis.
- 6b. \_\_\_\_\_ The parts will be stored in a secure project parts store with ESD protection.
- 6c. Project parts will be withdrawn from 5X stores by the process of "part kitting" which is initiated in EPINS by the project PIE or the parts representative upon receiving a request from a project-authorized person. Identify the people authorized to request part kitting by name or work assignment. \_\_\_\_\_
- 6d. \_\_\_\_\_ When flight parts are removed from 5X stores for kitting to the user, they shall be inspected by QA personnel for handling damage and confirmation that the part pedigree meets the project requirements. Exceptions to this requirement are usually made for most capacitors and resistors.

## 7. **Reliability and Performance Assessment**

Reliability and performance assessment consists of evaluating and/or testing parts to determine their capability to perform within their specifications under the environmental conditions of the project.

Check one or more:

- \_\_\_\_\_ Assess all nonstandard parts  
\_\_\_\_\_ Assess only selected nonstandard parts as recommended by the part specialists  
\_\_\_\_\_ 100% screening of flight part lots  
\_\_\_\_\_ 100% screening of selected flight part lots  
\_\_\_\_\_ Demonstration testing of selected parts (TBD) for mission lifetime capability  
\_\_\_\_\_ Destructive Physical Analysis (DPA) of samples from selected flight lots  
\_\_\_\_\_ 100% performance verification to the manufacturer's specification  
\_\_\_\_\_ Verification that the part manufacturer's part specification meets the requirements of the project.

## 8. **Part Parameter Derating**

The derating of various electronic part parameters from the part manufacturer's maximum ratings is known to improve the reliability of the parts.

- 8a. ☐ Part parameter derating per JPL Derating Guidelines D-8545 is required  
☐ Part parameter derating per other derating criteria is required  
Specify the document \_\_\_\_\_  
☐ No part parameter derating is required. The circuit designers will only be required to stay within the manufacturer's maximum ratings.

9. **Analysis of Failed Parts**

Flight quality electronic parts that fail at or after the first application of power to the flight assembly should be analyzed by the organization best qualified to perform the analysis.

- 9a. Analysis of failed parts shall be performed on (check one):

☐ All unexplained part failures  
☐ All parts related to project PFRs  
☐ Catastrophic part failures only  
☐ Selected part failures as recommended by a part specialist  
☐ No part failure analysis is required

- 9b. Failed parts in contractor's flight hardware shall be analyzed by the (check one):

☐ Contractor or its designee  
☐ JPL Office 507

- 9c. Failed parts in instrument flight hardware shall be analyzed by the (check one):

☐ Instrument organization or its designee  
☐ JPL Office 507

10. **GIDEP Alerts**

The review of GIDEP Alerts for application to parts used in flight hardware is a NASA mandate. See D-11119, Alerts/Concerns Handbook, for guidance.

- 10a. Parts lists shall be compared with GIDEP Alerts and the results reported by:  
(check one)

☐ Each organization building flight hardware (with a copy to JPL Office 507 for closure)  
☐ JPL Office 507 for all project parts (this assumes 507 has all parts lists)

- 10b. Parts lists shall be compared with GIDEP Alerts (check one or more):

☐ Before the parts are procured  
☐ Until launch, for each new Alert and each new part  
☐ Until the end of the mission, provided the doing organization is funded

11. **Disposition of Unallocated/Unneeded Parts**

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All parts purchased with JPL funds are Government property and subject to disposition by the project manager.

\_\_\_\_\_ Project parts purchased by JPL shall be held in the project's part store for use by the project until launch, or until \_\_\_\_\_.

\_\_\_\_\_ Unallocated/unneeded project parts may be sold to other JPL projects with the approval of the project manager (yes or no).

11a. Parts purchased by JPL contractors with funds provided by a cost-plus type contract are also subject to disposition by the project manager. Unallocated/unneeded parts shall be held in bonded stores by the contractor until launch (yes or no)\_\_\_\_\_, or until \_\_\_\_\_.

11b. Parts purchased by JPL and provided to a contractor with a fixed price contract are subject to disposition by the project manager. Unneeded parts shall be held in bonded stores by the contractor until launch \_\_\_\_\_, or until \_\_\_\_\_

**12. Electronic Parts Program Flowdown**

\_\_\_\_\_ All contractors for spacecraft hardware shall be required to flow down all relevant requirements in the Project Parts Program document.

\_\_\_\_\_ All contractors shall be required to monitor the compliance of their sub-contractors to the requirements in the Project Parts Program document.